<u>REMARKS</u>

Applicant and his attorney acknowledge with appreciation the courtesies shown by the examiner and her supervisor during the interview held on October 1, 2003. In accordance with the discussions at that interview, applicants have amended the claims in the application to more clearly define the invention, and have added claims to provide the scope of protection to which applicants are believed entitled. Accordingly, favorable reconsideration of the application in light of the following comments is respectfully requested.

As discussed, the present invention is directed to a sensor fusion system for simultaneously sensing thermally <u>emitted</u> radiation and <u>reflected</u> radiation in the visible NIR/SWIR from the same view and fusing these sensed images to provide important visual information to an observer. This simultaneous sensing is carried out by directing both emitted thermal and reflected visible radiation through a single achromatic objective lens and focusing both spectral ranges on the same focal plane so that all sensed radiation originates along exactly the same optical path. The received spectral images are directed by a beam splitter to respective sensors at the focal plane. The system thus provides precise co-registration of the received reflective visible/NIR/SWIR spectrum and thermal infrared spectrum images, regardless of the depth-of-field range of the scene being imaged, to enable precise integration of the images.

Attached as Appendix A is a copy of a slide that was used at the interview to illustrate the radiation spectra detected in the present invention. The left-hand image was obtained with radiation in the visible spectrum of about 0.4 to 0.7 microns, while the second image from the left was obtained with radiation in the short wave infrared (SWIR) at about 1.2 microns. The radiation for both images was reflected from the individual, who is the "scene" being viewed in this case; radiation in these wavelengths is reflected from scenes being viewed.

The two right-hand images are significantly different, for these images are obtained by measuring IR radiation which is emitted from the scene. These images were obtained at about 4.0 and 10.0 microns, respectively, in the spectral range of emitted IR.

As illustrated in the Appendix, and as described in the specification, images based on reflected and on emitted light provide distinctly different information about the scene, and this information can be combined to produce a composite image of the scene to provide valuable insights about the scene.

In order to obtain an accurate and reliable composite image in accordance with the invention, it is important to direct the radiation from the scene being imaged through the same optical path. To accomplish this, a highly achromatic lens is provided, so that images in both the reflected and the emissive spectral ranges are focused on a common focal plane. The received light is separated, after it has passed through the optics, by a beam splitter and the reflected and the emitted light spectra are directed to corresponding detectors for conversion to electrical signals and processing to produce a composite signal.

The claims in the present application have been rejected as unpatentable over Patent No. 6,222,187 to Shivanandan, under 35USC§103.

As discussed at the interview, the '187 patent is directed to a multiwavelength imaging and spectroscopic photoemission microscope system, in which the microscope includes a number of visible and infrared spectra objective lenses 122 mounted on a turret assembly 120. Light passes through the objective lenses and through a grating spectrometer 106, where grating 154 separates the light according to wavelength. The separated wavelengths are then directed to beam splitter 108. The spectrometer 106 divides the light into three bands: 200 nm to 600 nm (ultraviolet), 600 nm - 1000 nm (visible), and 1000 nm to 2500 nm (infrared).

One fundamental difference between the present invention and the '187 patent is that the patent defines the term "infrared" as being the spectrum of 1000 nm to 2500 nm (see Col 1, lines 22-23 and Col 4, line 9). However, this is the reflective infrared spectrum. (See Appendix A.) The present application, on the other hand, is directed to, and claims, the sensing of radiation both in the reflective spectrum and in the thermal infrared spectrum of 3-15 microns, (which is 3000 to 15000 nm). Thus, the present invention is directed to a system for accurately detecting and co-registering images in a subspectrum of visible/NIR/SWIR radiation and a subspectrum of thermal IR, and this is not taught in the prior art, and more particularly is not taught in the '187 patent.

It is respectfully pointed out that the optical system of the present invention is distinct from the system taught by the '187 patent in that present application discloses and now claims (see claim 1) an optical sensor having "a single superachromatic objective lens for focusing on a focal plane radiation in a subspectrum of the visible/NIR/SWIR reflective spectral region and in a subspectrum of the thermal IR 3-15 micron emissive spectral region form a scene". No such lens is found in the teachings of the reference. In contrast, the '187 reference describes the microscope 102 as including "a turret assembly 120 of visible and infrared objective lenses 122". It is unclear from this statement whether the lenses 122 include some for visible light and some for infrared radiation, or whether each of the several lenses is for both. Thus, the actual teaching of the reference with respect to the lens structure is unknown, and it is clear that such a vague description cannot teach, or even suggest, the single superachromatic objective lens capable of focusing on a focal plane both visible spectrum light and thermally emitted IR radiation, as is recited in the claim 1.

It is further pointed out that in the apparatus of claim 1, the light from the superachromatic objective lens is received by a beam splitter, which then directs the two

subspectra to corresponding sensor arrays without any additional optics, so that the radiation in both of the subspectra is transmitted through the same optics. This is an important feature which enables precise registration of the images during processing.

In contrast, in the apparatus described in the '187 patent, light from the lenses 122 is directed though a lens 132, band pass filters 140A and 140B, an optional spectrometer 106 which divides the light into three spectral bands, and then to a beam splitter 108 to divide visible and IR spectrum light to focal planes 110 and 112. As pointed out in the '187 patent at Col. 4, line 41 to Col. 5, line 6, IR light received at array 110 is detected, converted into electronic information, and analyzed in processor 200. As pointed out at Col. 5, lines 7-13, visible light at array 112 is converted to electronic information, and analyzed in processor 200. However, nowhere does the '187 patent suggest that a composite signal should be derived from these visible and IR signals.

The present invention, as defined in claim 1, clearly describes a device which is capable of processing reflective and thermally emissive radiation through a single optical system, dividing the subspectra, converting them to corresponding electrical signals and combining them to produce a composite signal, in a manner neither taught by, nor obvious from, the '187 reference.

Although it is asserted in the Office Action that it would be obvious from the '187 reference to select the thermal emission subspectrum, there is no teaching in the reference itself to support this. The problems inherent in focusing the widely different visible and thermal IR wavelengths to a focal plane in such a way as to permit accurate fusing of the images in the manner described and claimed herein are nowhere mentioned, much less solved, in the reference. Accordingly, it is respectfully submitted that the assertion of obviousness is not supported by the reference itself.

Claim 2 is dependent on claim 1, and is patentable for the reasons given above. Further, it is pointed out that the reference does not suggest the claimed optical intensifier structure. The assertion in the Office Action that it would be obvious to use an electronic amplifier is, of course, not disputed, since the reference does teach that. But that is not what is claimed; claim 2 is directed to an optical intensifier, and there is no suggestion in the reference that would support the assertion of obviousness.

Claim 3 is dependent on claim 2, and is directed to a display device for receiving the composite signal of claim 1. It is asserted that the '187 reference teaches this, but it is submitted that the reference itself does not support this assertion. The '187 patent shows a processor 200 and a computer 202, where the signals from the processor are "processed as digital information". It is submitted that this description neither teaches nor implies a display of the composite signal recited in the claims.

Claim 4 is dependent on claim 3, and further defines a processor and a control panel. The reference shows such features, but not for the purpose described in the claim; namely to process and control a composite signal.

Claim 5 describes the device of claim 4 as being a compact, hand-held device. It is asserted in the Office Action that such a feature is a matter of design, but it is respectfully pointed out that the microscope of the '187 reference does not suggest this.

Newly added claims 6-18 are dependent on claim 1, and thus are patentable for the reasons discussed above. Further, however, these claims define various features and combinations of features nowhere taught or suggested in the reference. For example, claim 6 defines a processor for deriving the composite signal of claim 1, and claim 7 defines the processor as including means to perform image fusion. This is not suggested in the '187 patent.

Claims 8 and 9 define an automated image detector for scene recognition, another feature not shown in the reference.

Claim 10 is dependent on claim 1 and defines the focal plane arrays, and distinguishes over the reference for the reasons already given.

Claim 11 defines the objective lens as being a multielement device that is superachromatic in the 0.4 to 14 micron range. No suggestion of this feature is found in the '187 reference.

Claim 12 defines a display for the composite signal, distinguishing over the reference for the reasons discussed above.

Claims 13 and 14 are dependent on claim 1 to further define the beam splitter of claim 1, and distinguish over the reference. Claim 15 is dependent on claim 1 and further defines the lens, claim 16 is dependent on claim 15 and adds details of the processor and controller structure, and claims 17 and 18 are dependent on claim 16 and add the display device and image detector. These claims all clearly define over the references for the reasons discussed above.

In view of the foregoing, it is respectfully submitted that the claims now in the application are clearly patentable, and favorable reconsideration is solicited.

Respectfully submitted,

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